Flexible Endoscopic Management of Zenker Diverticulum: The Mayo Clinic Experience

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OBJECTIVE: To describe the outcome of patients undergoing flexible endoscopic therapy for symptomatic Zenker diverticulum.

PATIENTS AND METHODS: We retrospectively evaluated the outcome of 22 consecutive patients who underwent flexible endoscopic cricopharyngeal myotomy using needle-knife electrocautery performed by a single endoscopist from March 2006 through January 2010.

RESULTS: Of the 22 patients with symptomatic Zenker diverticulum, 13 were men and 9 were women (median age, 84.5 years). Moderate sedation was used in all but 3 (14%) of the patients. Postprocedural free air occurred in 6 patients (27%) and resolved uneventfully in all. Another patient developed a neck abscess 1 week after endoscopic treatment, which was surgically drained. All procedures were performed on an outpatient basis, although 8 patients (36%) required subsequent hospitalization. The mean (SD) length of stay in the hospital was 2.9 (1.64) days. All patients had initial symptomatic improvement, and 18 (82%) maintained improvement at a mean (SD) follow-up of 12.7 (9.2) months.

CONCLUSION: Flexible endoscopic cricopharyngeal myotomy is an effective treatment of symptomatic Zenker diverticulum, with low recurrence rates and with the benefit of no general anesthesia and hospitalization in most cases. Esophageal perforation is the most common procedural complication.

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CP = cricopharyngeal; NG = nasogastric

Zenker diverticulum, a common type of esophageal diverticulum, is caused by dysfunction of the cricopharyngeal (CP) muscle (Figure 1).[1] It is generally a disease of the elderly and causes dysphagia that is often complicated by malnutrition and aspiration. Open surgical techniques, such as diverticulectomy with or without CP myotomy, have gradually been replaced by rigid endoscopic CP myotomy as the treatment of choice.[2,3] Rigid endoscopic CP myotomy requires hyperextension of the neck and is performed in the operating room, usually by ear, nose, and throat surgeons, with general endotracheal anesthesia. Brief hospitalization is common, with some delay in resumption of oral intake. Flexible endoscopic therapy for symptomatic Zenker diverticula is another method used to perform CP myotomy. Performed by endoscopists (gastroenterologists or surgeons), it was first introduced in 1995[4] as an alternative to open surgical and rigid endoscopic techniques; however, outcome data are still relatively limited, and, except for one small series, are from studies performed outside the United States.[4-11] Preliminary data suggest that flexible endoscopic therapy may result in similar success rates, low recurrence rates, and low complication rates,

with several added advantages[1]: the procedure is performed without general anesthesia and in an outpatient setting, and resumption of oral intake is more rapid. In this case series, we describe the Mayo Clinic experience with flexible endoscopic CP myotomy and several important outcome measures.

PATIENTS AND METHODS

This study was approved by the Mayo Clinic Institutional Review Board.

From March 2006 through January 2010, consecutive patients with symptomatic Zenker diverticulum were referred to a single endoscopist (gastroenterologist, T.H.B.) for endoscopic treatment using flexible endoscopic CP myotomy without diverticulectomy. Data were abstracted retrospectively from endoscopy reports, radiographic imaging reports, and clinical notes and were entered into a computerized database. Diagnosis of Zenker diverticulum was made by barium esophagraphy and confirmed at the time of endoscopy. Prophylactic antibiotic treatment was not routinely administered. All patients underwent only 1 treatment session. Procedure outcome was evaluated according to the following parameters: (1) symptom resolution immediately afterward; (2) complications including bleeding or perforation; (3) required length of hospitalization (if any); and (4) recurrence of symptoms. Perforation was diagnosed on endoscopic visualization and/or the clinical or radiographic presence of subcutaneous or mediastinal emphysema after the procedure. Follow-up continued until patient death or last telephone contact.

TECHNIQUE

Patients were placed in the left lateral decubitus position (for link to supplemental video demonstrating the technique, see Supporting Online Material at end of article). Moderate sedation (intravenous fentanyl or meperidine and midazolam) was administered in 19 patients (86%). Anesthesia assistance was needed in 3 patients: general

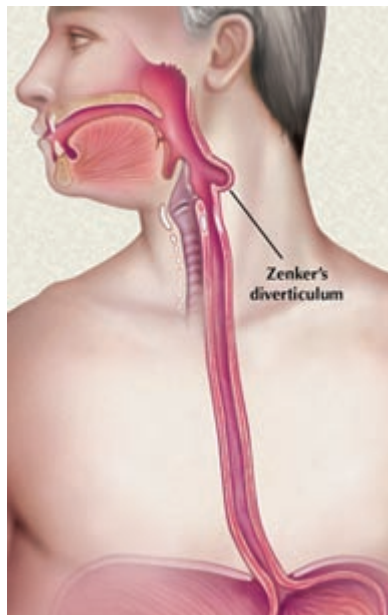© 2010 Mayo Foundation for Medical Education and Research

FIGURE 1. Anatomy of Zenker diverticulum.
From *Dis Esophagus,*[1] with permission from Wiley-Blackwell.

anesthesia in 2 and monitored anesthesia care in 1. Standard flexible endoscopes were used in all patients.

After an initial endoscopic examination, a standard nasogastric (NG) tube was placed into the esophagus over an endoscopically placed guidewire to allow better visualization of the septum, by separating the esophageal lumen from the diverticulum (Figure 2, top). After the esophageal lumen was correctly identified, the endoscope was passed through the cricopharyngeus and past the Zenker diverticulum. After the stomach and duodenum were examined, a guidewire was passed into the stomach or duodenum, and the endoscope was withdrawn. The tip of the NG tube was cut off to allow passage of the guidewire. In the early years, the NG tube was placed transorally. In the later years, the NG tube was placed transnasally after passing a pediatric (5.4-mm) endoscope transnasally into the stomach, leaving a standard (0.89-mm [0.035-in]) guidewire in place, and removing the endoscope.

A standard adult upper endoscope (10 mm) was then passed transorally alongside the NG tube to the level of the Zenker diverticulum and the cricopharyngeus. Cricopharyngeal myotomy was performed with a biliary needle knife (Figure 2, middle) (Huibregtse Single Lumen Needle Knife, Cook Endoscopy, Winston-Salem, NC) and electrocautery (ERBE electrosurgical generator ICC 200, ERBE, Marietta, GA, at a setting of 200/25) as previously described (Figure 2, bottom).[1,7,8,12] A transparent cap was used in 3 instances for better exposure of the CP septum and muscle.[5,7,8,12,13]

FIGURE 2. Endoscopic view of cricopharyngeal myotomy. Top, Nasogastric tube within the esophageal lumen allows easy identification of the Zenker diverticulum (arrow). Middle, Initial needle-knife incision. Bottom, After completed myotomy.
From *Dis Esophagus,*[1] with permission from Wiley-Blackwell.

Intraprocedural bleeding was managed with epinephrine (1:10,000) injection. Endoscopically visible perforation was closed using an endoclip application (QuickClip, Olympus, Center Valley, PA; or Resolution Clip, Boston Scientific, Natick, MA). The NG tube remained in place until the pa-

tient was discharged from the outpatient recovery area. If the patient was admitted to the hospital after the procedure, the NG tube remained in place.

RESULTS

All procedures in the 13 men and 9 women were performed in the outpatient setting. Eight patients (36%) were hospitalized after the procedure. The mean (SD) length of hospitalization was 2.9 (1.64) days. The need for hospitalization was related to observation after mediastinal or subcutaneous free air was identified on imaging in 6 patients and because of advanced age and debility in 2 patients.

Intraprocedural bleeding occurred in 5 patients (23%), was not clinically meaningful, and was not a reason for hospitalization. Perforation occurred in 6 patients (27%); it led to hospitalizations of 3 to 5 days in 4 patients and overnight observation in 2 patients. Initially, 1 patient had complete symptom resolution but developed a neck abscess 1 week later, which was surgically drained, that led to a 9-day hospital stay. Fourteen patients (64%) had no complications. All patients had substantial symptomatic relief after the procedure. At a mean (SD) follow-up of 12.7 (9.2) months, 4 patients (18%) had recurrent symptoms to baseline level, 3 patients (14%) had moderate improvement in their symptoms, and 15 patients (68%) maintained complete or near-complete resolution of symptoms (Table).

TABLE. **Demographics, Complications, and Outcomes in Patients Undergoing Flexible Endoscopic Cricopharyngeal Myotomy**

No. of patients	22
Age (y), median (range)	84.5 (59-96)
Prior therapy failed	4 (18)
Deemed nonoperative candidate	5 (23)
Moderate sedation	19 (86)
Complications	
None	14 (64)
Minor bleeding	5 (23)
Esophageal perforation	6 (27)
Neck abscess	1 (4.5)
Need for hospitalization	8 (36)
Days hospitalized (if necessary)	
mean (SD)	2.9 (1.64)
Outcomes	
Symptomatic improvement (initial)	22 (100)
Follow-up (mo)	
mean (SD)	12.7 (9.2)
At last follow-up:	
Complete/near-complete	
symptom resolution	15 (68)
Moderate symptom improvement	3 (14)
Complete symptom recurrence	4 (18)

Values are number (percentage), unless indicated otherwise.

DISCUSSION

Zenker diverticulum is a substantial cause of morbidity in elderly patients. Flexible endoscopic therapy is a relatively new approach compared to open surgical and rigid endoscopic techniques, and outcome data are still relatively limited. In a review of recent literature on flexible endoscopic therapy (6 studies involving 184 patients, in which the following data were reported), symptomatic improvement was found in 85% with a symptom recurrence rate of 18%. Bleeding occurred in 0% to 14% of patients, and subcutaneous or mediastinal emphysema (due to esophageal perforation) occurred in 0% to 23% of patients.[1,5,7-9,12,14]

Our experience with flexible endoscopic CP myotomy has yielded promising results. Procedure success as defined by immediate symptom resolution was 100%, similar to success rates reported elsewhere.[5,7,9,15] All procedures were performed on an outpatient basis, with subsequent hospitalization required in 36% of the patients. The median length of hospitalization (if necessary) was 3.5 days. Only 23% of the procedures were complicated by mild bleeding, which was easily controlled with epinephrine injection. The perforation rate (27%) was slightly higher than that of earlier studies.[1,5,7-9,12,14,15] Of the 6 patients in whom perforation was identified, 3 required hospitalization for 3 or fewer nights (mild severity), 2 required 4 nights (moderate severity), and only 1 required admission to the intensive care unit (severe).[16] At a mean (SD) follow-up of 12.7 (9.2) months, 68% of patients had complete or near-complete resolution of symptoms, 14% had moderate improvement of their symptoms, and 18% had complete recurrence of symptoms. These rates are also comparable to those in earlier studies.[1,5,7-9,12,14] Of importance, only 14% of the patients required more than moderate sedation, and neck hyperextension was avoided in all patients.

Our patient population was a group of elderly high-risk surgical patients. Many were considered unsuitable for rigid endoscopic therapy because of advanced age and underlying severe comorbid medical illnesses. Four patients had already undergone surgical CP myotomy, and many had severe cervical spine disease and were unable to hyperextend their neck, a requirement for rigid endoscopic therapy. Therefore, direct comparison to rigid endoscopic (surgical) data is not possible.

At our medical center, patients who are good operative candidates undergo rigid endoscopic therapy; however, in some centers outside the United States, flexible endoscopic therapy is offered to all symptomatic patients. Our study differs from other studies in that only 1 procedure was performed. Whether our patients with suboptimal clinical response or recurrent symptoms had a more seri-

ous swallowing disorder or would have benefited from additional flexible endoscopic therapy is unknown.

The techniques for flexible endoscopic therapy are not standardized as they are for rigid endoscopic CP myotomy. In addition, the learning curve for endoscopic techniques is unknown. Because flexible endoscopic therapy is not performed in the vast majority of US medical centers, opportunity for training is limited; thus, these data cannot be generalized to other endoscopists and centers. However, an animal model has been described[17] that could allow for hands-on training and that could result in more widespread application of flexible endoscopic techniques.

Some devices, such as the soft diverticuloscope,[13] which allows better exposure and is associated with better outcomes after flexible endoscopic therapy, are not available in the United States. New devices and techniques to improve the safety and efficacy of flexible endoscopic therapy have been introduced in animal studies,[18,19] and clinical trials in humans are awaited. Novel flexible endoscopic techniques such as clip-assisted diverticulotomy have demonstrated encouraging results.[10,11]

CONCLUSION

This study is limited by its small sample size and performance by a single endoscopist, lack of direct comparison to a group treated by rigid endoscopic methods, and lack of a standardized tool by which the patients could quantify symptomatic improvement. Nonetheless, our experience suggests that, when performed by an experienced therapeutic endoscopist, flexible endoscopic CP myotomy is a safe and effective treatment option for symptomatic Zenker diverticulum. Future studies comparing flexible endoscopic methods to rigid endoscopic methods are necessary to further determine the optimal treatment of symptomatic Zenker diverticulum. Currently, we think that this technique is a viable alternative in patients in whom surgery is not an option.

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